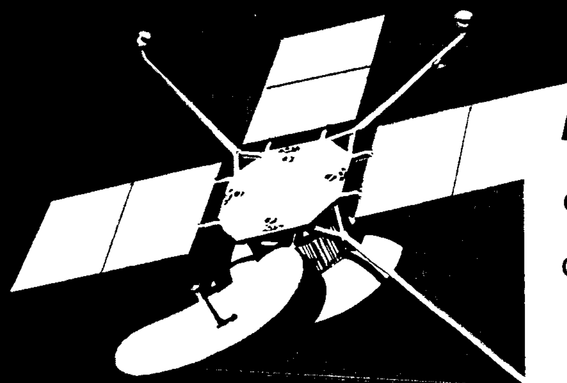
VOYAGER SPACECRAFT SYSTEM

FINAL TECHNICAL REPORT

VOLUME E

DESIGN FOR OPERATIONAL SUPPORT EQUIPMENT—1969 TEST FLIGHT



prepared for JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY

UNDER CONTRACT NO. 951111 JULY 1965

NAS-7-100

THE BOEING COMPANY • AERO-SPACE DIVISION • SEATTLE, WASHINGTON

NASA CR71509

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JULY 1965

THE BOEING COMPANY • AERO-SPACE DIVISION • SEATTLE, WASHINGTON

THE BOEING COMPANY
SEATTLE, WASHINGTON 98124

LYSLE A. WOOD
VICE PRESIDENT-GENERAL MANAGER
AERO-SPACE DIVISION

July 29, 1965

Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, California

Gentlemen:

This technical report culminates nearly three years of Mariner/Voyager studies at Boeing. During this time, we have gained an appreciation of the magnitude of the task, and feel confident that the experience, resources and dedication of The Boeing Voyager Team can adequately meet the challenge.

The Voyager management task is accentuated by three prime requirements: An inflexible schedule of launch opportunities; the need for an information-retrieval system capable of reliable high-traffic transmission over interplanetary distances; and a spacecraft design flexible enough to accommodate a number of different mission requirements. We believe the technical approach presented here satisfies these design requirements, and that management techniques developed by Boeing for space programs will assure delivery of operable systems at each critical launch date.

Mr. E. G. Czarnecki has been assigned program management responsibility. His group will be ably assisted by Electro-Optical Systems in the area of spacecraft power, Philco Western Development Laboratories will be responsible for telecommunications, and the Autonetics Division, North American Aviation will provide the auto-pilot and attitude reference system. This team has already demonstrated an excellent working relationship during the execution of the Phase IA contract, and will have my full confidence and support during subsequent phases.

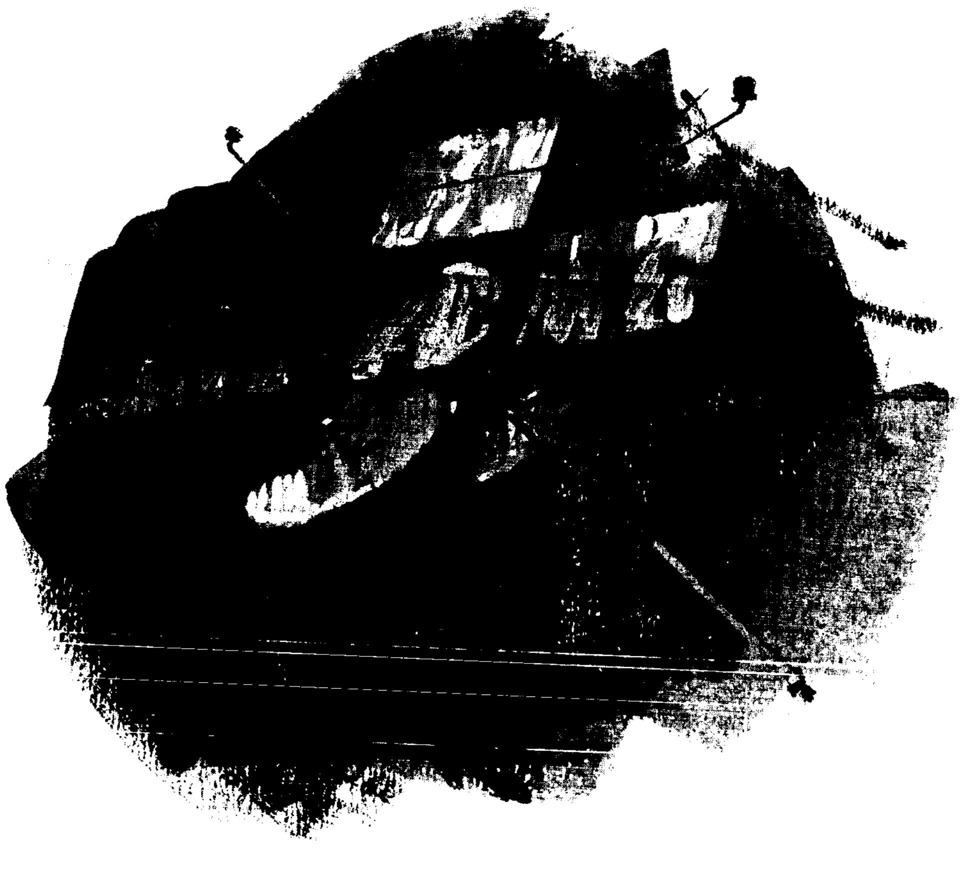
This program will report directly to George H. Stoner, Vice President and Assistant Division Manager for Launch and Space Systems. Mr. Stoner has the authority to assign the resources necessary to meet the objectives as specified by JPL.

The Voyager Spacecraft System represents to us more than a business opportunity or a new product objective. We view it as a chance to extend scientific knowledge of the universe while simultaneously contributing to national prestige and we naturally look forward to the opportunity of sharing in this adventure.

Lysle A. Wood

Lysle A. Wood

CONTENTS



INTRODUCTION

INTRODUCTION

In fulfillment of the Jet Propulsion Laboratory (JPL) Contract 951111, the Aero-Space Division of the Boeing Company submits the Voyager Spacecraft Final Technical Report. The complete report, responsive to the documentation requirements specified in the Statement of Work, consists of the five following documents:

VOLUME	TITLE	BOEING DOCUMENT NUMBER
A	Preferred Design Flight Spacecraft and Hardware Subsystems	D2-82709-1
	Part I	
	Section 1.0 Voyager 1971 Mission Objectives and Design Criteria	
	Section 2.0 Design Characteristics and Restraints	
	Section 3.0 System Level Functional Descriptions of Flight Spacecraft	
	Part II	
	Section 4.0 Functional Description for Spacecraft Hardware Subsystems	
	Part III	
	Section 5.0 Schedule and Implementation Plan	
	Section 6.0 System Reliability Summary	
	Section 7.0 Integrated Test Plan Development	
B	Alternate Designs Considered-Flight Spacecraft and Hardware Subsystems	D2-82709-2
C	Design for Operational Support Equipment	D2-82709-3
D	Design for 1969 Test Spacecraft	D2-82709-4
E	Design for Operational Support Equipment for 1969 Test Flight Spacecraft	D2-82709-5

For convenience the highlights of the above documentation have been summarized to give an overview of the scope and depth of the technical effort and management implementation plans produced during Phase IA. This summary is contained in Volume 0, Program Highlights and Management Philosophy, D2-82709-0. A number of supporting documents are provided to furnish detailed information developed through the course of the contract and to provide substantiating reference material which would not otherwise be readily available to JPL personnel. Additionally, a full scale mock-up of the preferred design spacecraft has been assembled. This mock-up, shown in Figure 1, has been delivered to JPL. The mock-up has been provided with the view that it would be of value to JPL in subsequent Voyager Spacecraft System planning. Mr. William M. Allen, President of The Boeing Company, Mr. Lysle A. Wood, Vice-President and AeroSpace Division General Manager, Mr. George H. Stoner, Vice-President and Assistant Division Manager responsible for Launch and Space Systems activities, and Mr. Edwin G. Czarnecki, Voyager Program Manager, are shown with the mockup.

During the three month period covered by Contract 951111, Boeing has:

1) Performed system analysis and trade studies necessary to achieve an optimum or preferred design of the Flight Spacecraft.
2) Determined the requirements and constraints which are imposed upon the Flight Spacecraft by the 1971 mission and by the other systems and elements of the project, including the science payload.
3) Developed functional descriptions for the Flight Spacecraft and for each of its hardware subsystems, excluding the science payload.

Figure 1: Preferred Design Mockup

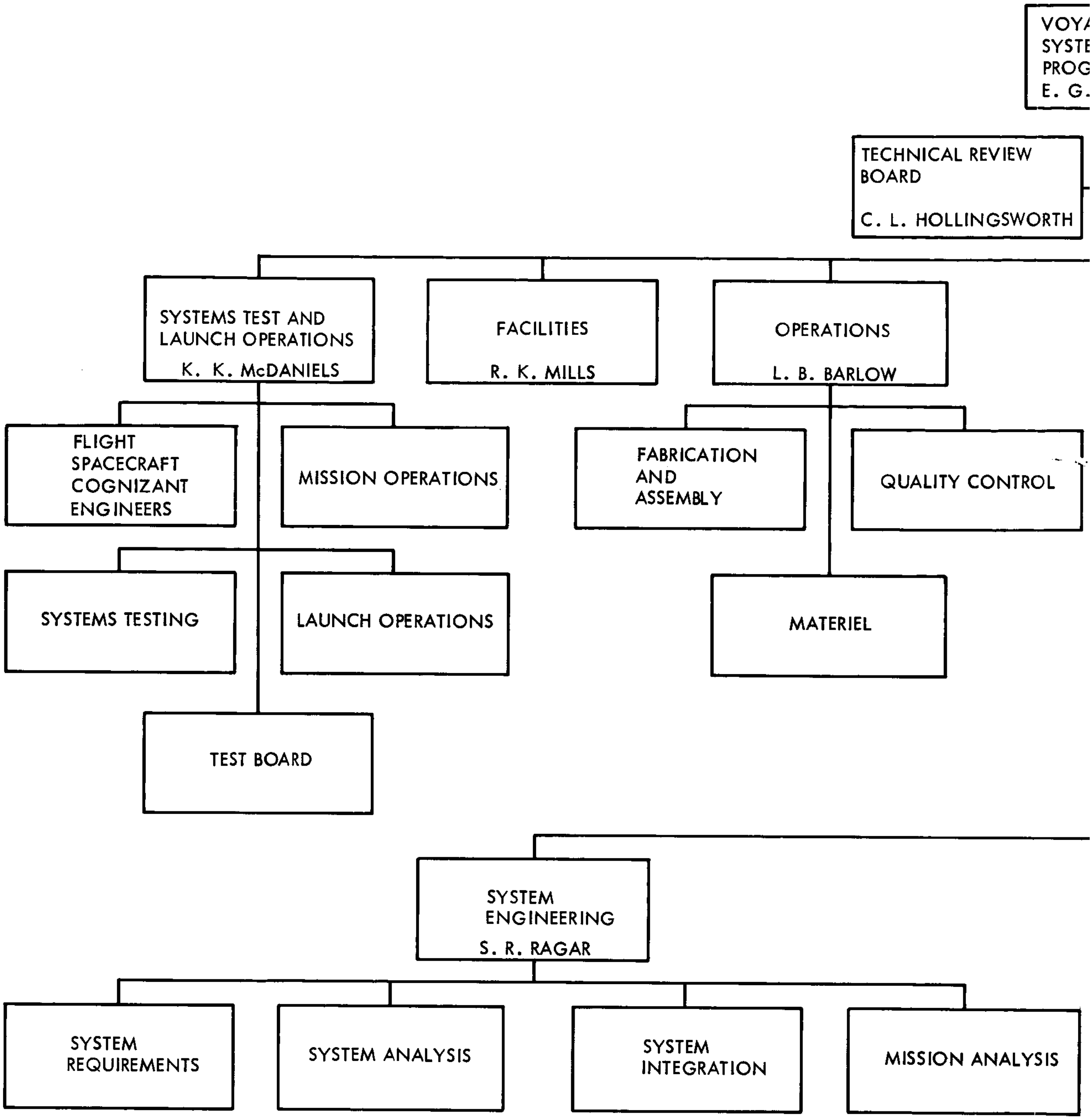
Left to Right:

William M. Allen
Edwin G. Czarnecki
Lysle A. Wood
George H. Stoner

4) Determined the requirements for the Flight Spacecraft associated Operational Support Equipment (OSE) necessary to accomplish the Voyager 1971 mission.
5) Developed a preliminary design of the OSE.
6) Developed functional descriptions for the OSE.
7) Determined the objectives of a 1969 test flight and the design of the 1969 Test Flight Spacecraft using the Atlas/Centaur Launch Vehicle. An alternate test flight program is presented which utilizes the Saturn IB/Centaur Launch Vehicle.
8) Developed functional descriptions for the Flight Spacecraft Bus, and its hardware subsystems, and OSE for the 1969 test spacecraft.
9) Updated and supplemented the Voyager Implementation Plan originally contained in the response to JPL Request for Proposal 3601.

The Voyager program management Team, shown in Figure 2 is under the direction of Mr. Edwin G. Czarnecki. Mr. Czarnecki is the single executive responsible to JPL and Boeing management for the accomplishment of the Voyager Spacecraft Phase IA, and will direct subsequent phases of the program. He reports directly to Mr. George H. Stoner who has the authority to commit those corporate resources necessary to fulfill JPL's Voyager Spacecraft System objectives.

Although Boeing has a technical management capability in all aspects of the Voyager Program, it is planned to extend this capability in depth through association with companies recognized as specialists in certain fields. Use of team members to strengthen Boeing's capability



TECHNICAL REVIEW BOARD
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SYSTEMS TEST AND LAUNCH OPERATIONS
K. K. McDANIELS
FACILITIES
R. K. MILLS
OPERATIONS
L. B. BARLOW
FLIGHT SPACECRAFT COGNIZANT ENGINEERS
MISSION OPERATIONS
FABRICATION AND ASSEMBLY
QUALITY CONTROL
SYSTEMS TESTING
LAUNCH OPERATIONS
MATERIEL
TEST BOARD
SYSTEM ENGINEERING
S. R. RAGAR
SYSTEM REQUIREMENTS
SYSTEM ANALYSIS
SYSTEM INTEGRATION
MISSION ANALYSIS

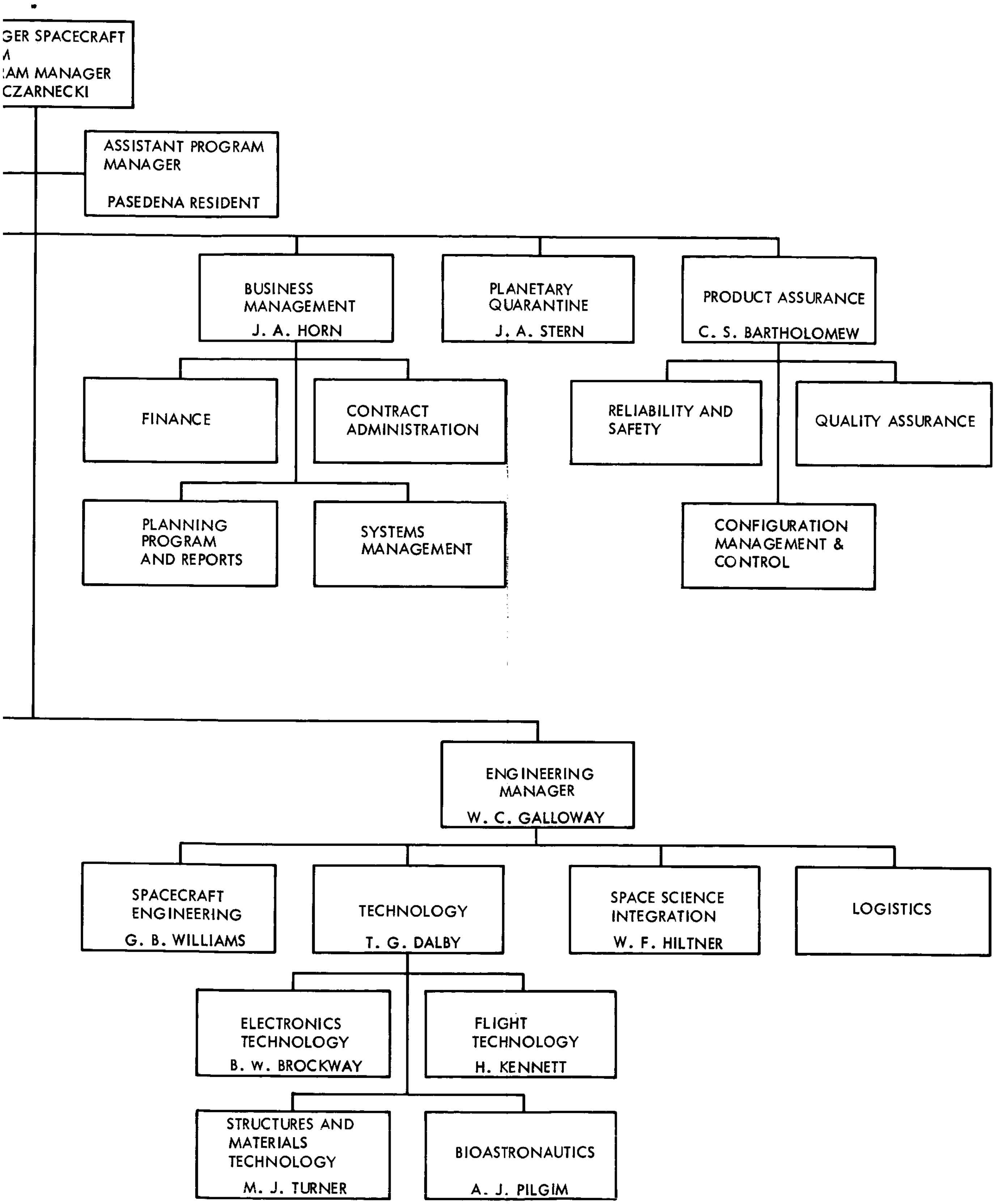


Figure 2 Boeing Voyager Spacecraft Systems Management Structure

2

was considered early during pre-proposal activities. The basic concept was to add team members who would complement Boeing experience and capability, and significantly improve the amount and quality of technical and management activities. Based upon competitive considerations including experience and past performance and giving strongest emphasis to technical qualifications and management willingness to support the Voyager effort, Autonetics, Philco Western Development Laboratories, and Electro-Optics Systems were chosen as team members. This team arrangement, subject to JPL approval, is shown in Figure 3. The flight spacecraft design and integration task to be accomplished by this Team is illustrated in Figure 4. Discussions leading to the formation of this team were initiated late in 1964, formal work statement agreements have been arrived at, and there has been a continuous and complete free exchange of information and documentation; permitting the Boeing team to satisfy JPL's requirements in depth and with confidence.

<table>
<tr><td colspan="3">BOEING VOYAGER TEAM

VOYAGER SPACECRAFT AND SPACE SCIENCES PAYLOAD INTEGRATION CONTRACTOR

The Boeing Company
Seattle, Washington

Mr. E. G. Czarnecki - Program Manager</td></tr>
<tr><td>SUBCONTRACTOR

Autonetics, North
American Aviation
Anaheim, California

Autopilot and
Attitude Refer-
Subsystem

Mr. R. R. Mueller
Program Manager</td><td>SUBCONTRACTOR

Philco, Western
Development Lab.
Palo Alto, California

Telecommunication
Subsystem

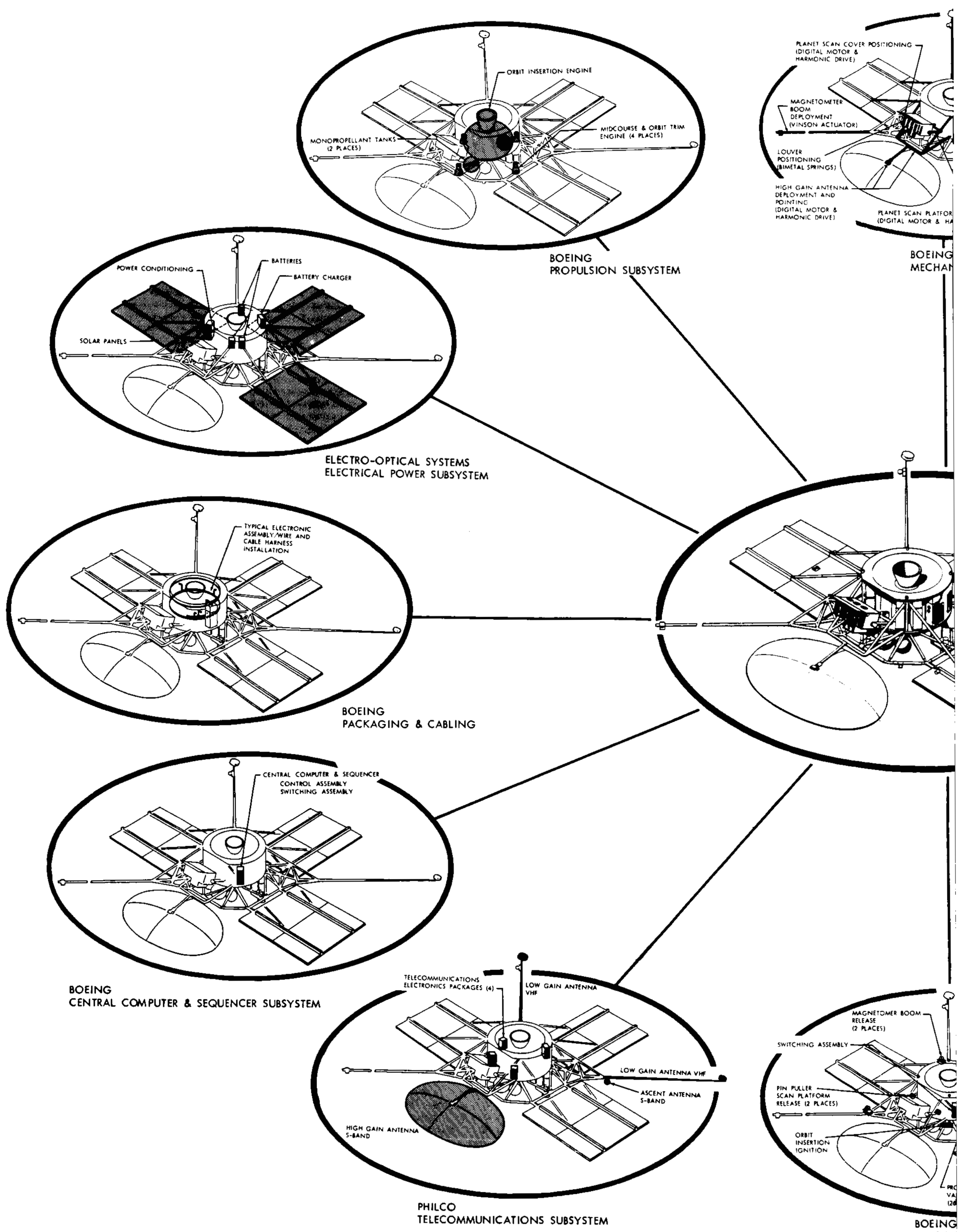
Mr. G. C. Moore
Program Manager</td><td>SUBCONTRACTOR

Electro-Optical Systems, Inc.
Pasadena, California

Electrical Power
Subsystem

Mr. C. I. Cummings
Program Manager</td></tr>
</table>

FIGURE 3


ORBIT INSERTION ENGINE
MONOPROPELLANT TANKS (2 PLACES)
MIDCOURSE & ORBIT TRIM ENGINE (4 PLACES)
BOEING
PROPULSION SUBSYSTEM
PLANET SCAN COVER POSITIONING (DIGITAL MOTOR & HARMONIC DRIVE)
MAGNETOMETER BOOM DEPLOYMENT (VINSON ACTUATOR)
LOUVER POSITIONING (BIMETAL SPRINGS)
HIGH GAIN ANTENNA DEPLOYMENT AND POINTING (DIGITAL MOTOR & HARMONIC DRIVE)
BOEING
POWER CONDITIONING
BATTERIES
BATTERY CHARGER
SOLAR PANELS
ELECTRO-OPTICAL SYSTEMS
ELECTRICAL POWER SUBSYSTEM
TYPICAL ELECTRONIC ASSEMBLY/WIRE AND CABLE HARNESS INSTALLATION
BOEING
PACKAGING & CABLING
CENTRAL COMPUTER & SEQUENCER
CONTROL ASSEMBLY
SWITCHING ASSEMBLY
BOEING
CENTRAL COMPUTER & SEQUENCER SUBSYSTEM
TELECOMMUNICATIONS ELECTRONICS PACKAGES (4)
LOW GAIN ANTENNA VHF
LOW GAIN ANTENNA VHF
ASCENT ANTENNA S-BAND
HIGH GAIN ANTENNA S-BAND
PHILCO
TELECOMMUNICATIONS SUBSYSTEM
MAGNETOMER BOOM RELEASE (2 PLACES)
SWITCHING ASSEMBLY
PIN PULLER SCAN PLATFORM RELEASE (2 PLACES)
ORBIT INSERTION IGNITION
BOEING

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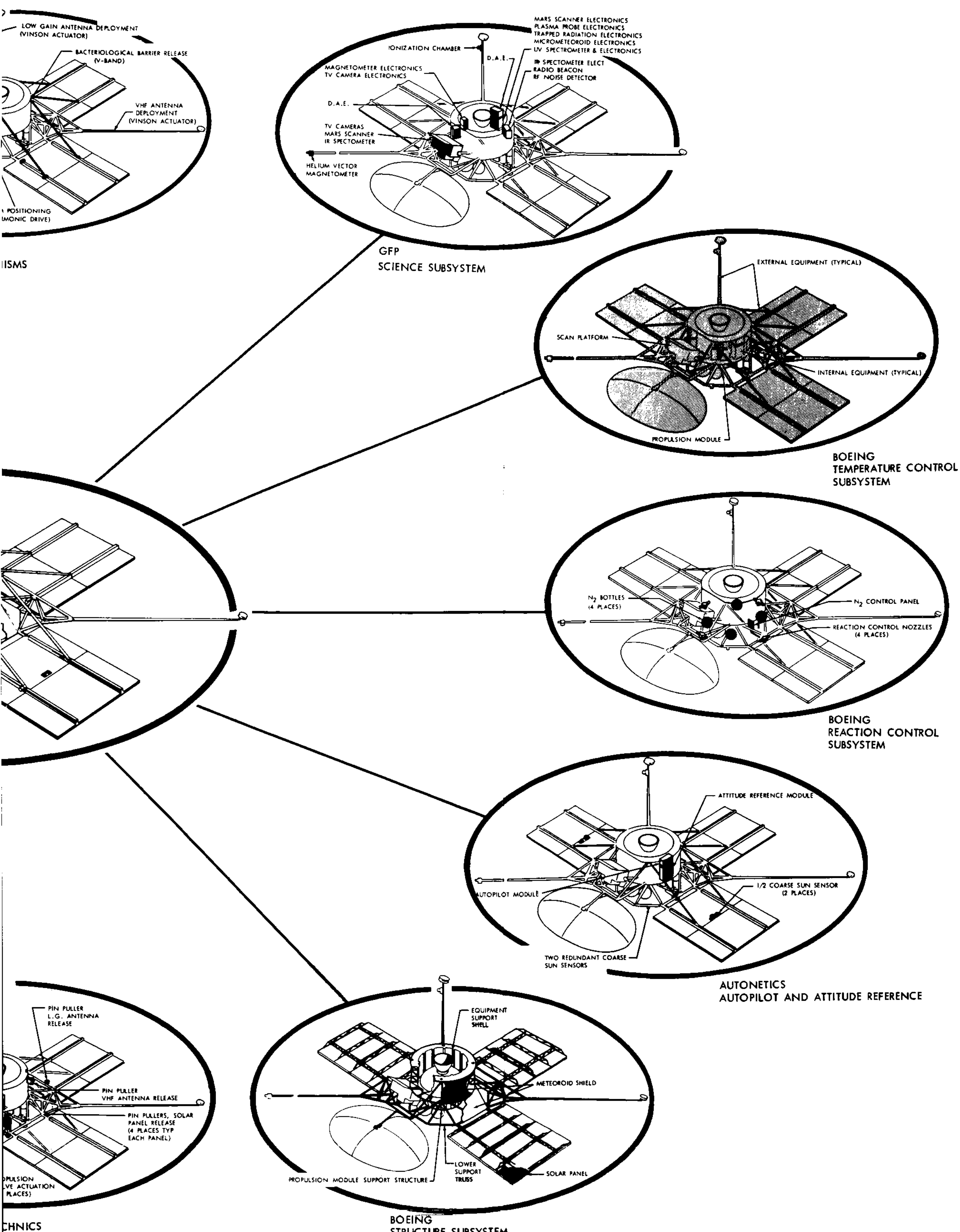


Figure 4: Voyager Flight Spacecraft Subsystem Integration

2

This document, D2-82709-5, Design for Operational Support Equipment for 1969 Test Flight, is summarized below.

OSE preliminary design data is presented for both the Atlas/Centaur launched 1969 test flight and the alternately proposed Saturn IB/ Centaur launched 1969 test flight. The basic philosophy of the design of OSE for the 1969 test flight includes the use of 1971 Voyager OSE with minimum modifications wherever practicable.

Design for OSE for the 1969 test flight is presented by noting the differences and exceptions to the material presented in D2-82709-3 (Design for OSE, 1971 Voyager Mission). In broad terms, the differences and exceptions which influence OSE design for the 1969 test flight relate to the fact that a science package and a flight capsule are not planned for the Atlas/Centaur launched test flight, and only simulated science packages and flight capsules are planned for the Saturn IB/Centaur launched test flight.

PART I OSE FOR 1969 TEST FLIGHT, GENERAL

PART I, OSE FOR 1969 TEST FLIGHT, GENERAL

This volume describes the preliminary design of Operational Support Equipment required to support each of the two 1969 test flight spacecraft configurations defined by D2-82709-4, "Design for 1969 Test Spacecraft." These two configurations are:

1) Atlas/Centaur launched 1969 test spacecraft;
2) Saturn IB/Centaur launched 1969 test spacecraft.

The 1969 test OSE design is presented in the same manner used for the 1969 test spacecraft in D2-82709-4. OSE for the Atlas/Centaur launched test flight is presented in Part II and OSE for the Saturn IB/Centaur launched test is presented in Part III. In order to avoid repetition, the OSE design for each of these test flights is defined as exceptions to the 1971 mission OSE design defined in D2-82709-3.

The OSE design philosophy for the 1969 test flight involves the use of 1971 mission OSE with minimum modification. The employment of 1971 OSE concepts, technologies and equipment for the 1969 test will achieve improved probability of 1971 mission success by a) providing validation of designs and specific hardware through actual use under mission conditions; b) identifying specific problem areas for correction; and c) developing procedures, and personnel skills prior to the 1971 mission operation.

CONTENTS

PART II OSE FOR ATLAS/CENTAUR LAUNCHED 1969 TEST FLIGHT

II 1.0 OSE OBJECTIVES AND DESIGN CRITERIA

This section of the document records the objectives and design criteria that apply to the operational support equipment (OSE) for the 1969 test spacecraft launched by the Atlas/Centaur.

Definitions of the various required categories of OSE are identical to those in Section 1.0 of D2-82709-3 except that: 1) References to the Science Package, or the Flight Capsule do not apply; 2) References to the Planetary Vehicle where used in the sense of the ultimate flight article apply to the test flight spacecraft.

II 1.1 SPACECRAFT SYSTEM OSE OBJECTIVES AND CRITERIA

The primary objective of the operational support equipment (OSE) for 1969 test flight is the enhancement of the probability of success for the Voyager 1971 mission. Additional OSE objectives in support of the 1969 test spacecraft are identical to those listed in D2-82709-3, Paragraph 1.1.

II 2.0 OSE DESIGN CHARACTERISTICS AND RESTRAINTS

The OSE design characteristics and restraints for the Voyager-71 mission, noted in Section 2.0 of D2-82709-3, apply to the Atlas/Centaur launched 1969 test spacecraft except as noted below.

All references in Section 2.0 of D2-82709-3 to the Science Package or the Flight Capsule, or to any operations involving or resulting from assembly or integration of these units with the spacecraft bus into a Planetary Vehicle, are not applicable. Where used in the sense of the ultimate flight article, the term "Planetary Vehicle" is changed to read "1969 Test Flight Spacecraft."

II 2.1 OSE SEQUENTIAL FLOW CHART

The processing of the flight hardware for the 1969 test flight spacecraft and the related 1969 PTM test activities are essentially the same as those shown in the flow chart of D2-82709-3, Figure 2.1-1 and the analysis matrices of Figures 2.1-2 through 2.1-6. In fact, the duplication of the kinds of tests and their sequencing is significant to proofing or validation of this processing for the 1971 mission flight hardware processing.

The differences in flow that are a consequence of differences in test flight configuration requirements are as follows:

1) Test and operations activities for the capsule, solid motor, and science package are deleted for the Atlas/Centaur launched test flight spacecraft.
2) The mission profile is a Mars flyby rather than a Mars orbital flight.

II 2.2 OSE DESIGN PARAMETERS

OSE design parameters for the Atlas/Centaur launched 1969 test flight are the same as those defined for the 1971 mission in D2-82709-3, Section 2.2, Tables 2.2-1 through 2.2-4, with the following exceptions:

1) Launch Pads 36A and 36B are used instead of Pads 34 and 37.

2) Two flight-ready Test Flight Spacecraft shall be made ready for each launch, one on each launch pad. A test model will be used as a source of flight acceptable spares.

3) The term "Planetary Vehicle" is replaced by "Test Flight Spacecraft."

II 2.3 OSE DESIGN CRITERIA

OSE design criteria for the Atlas/Centaur launched 1969 test flight are identical to those defined for the 1971 mission in D2-82709-3, Paragraph 2.3.

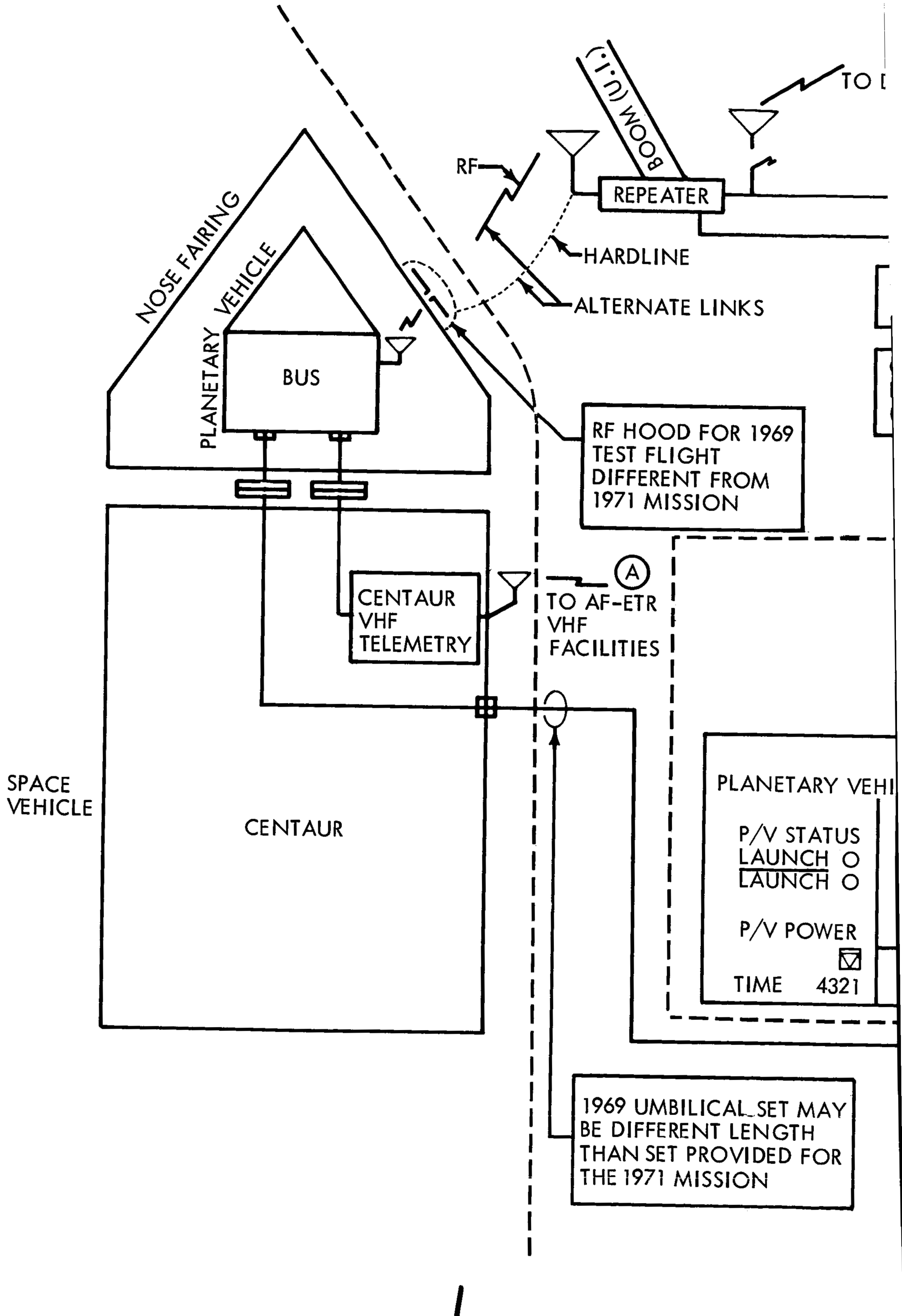
II 3.0 FUNCTIONAL DESCRIPTION - SYSTEMS LEVEL

Functional descriptions for system level OSE for the Atlas/Centaur launched 1969 test flight are identical to those noted for the Voyager '71 mission as defined in Section 3.0 of D2-82709-3, except as noted in the following subsections.

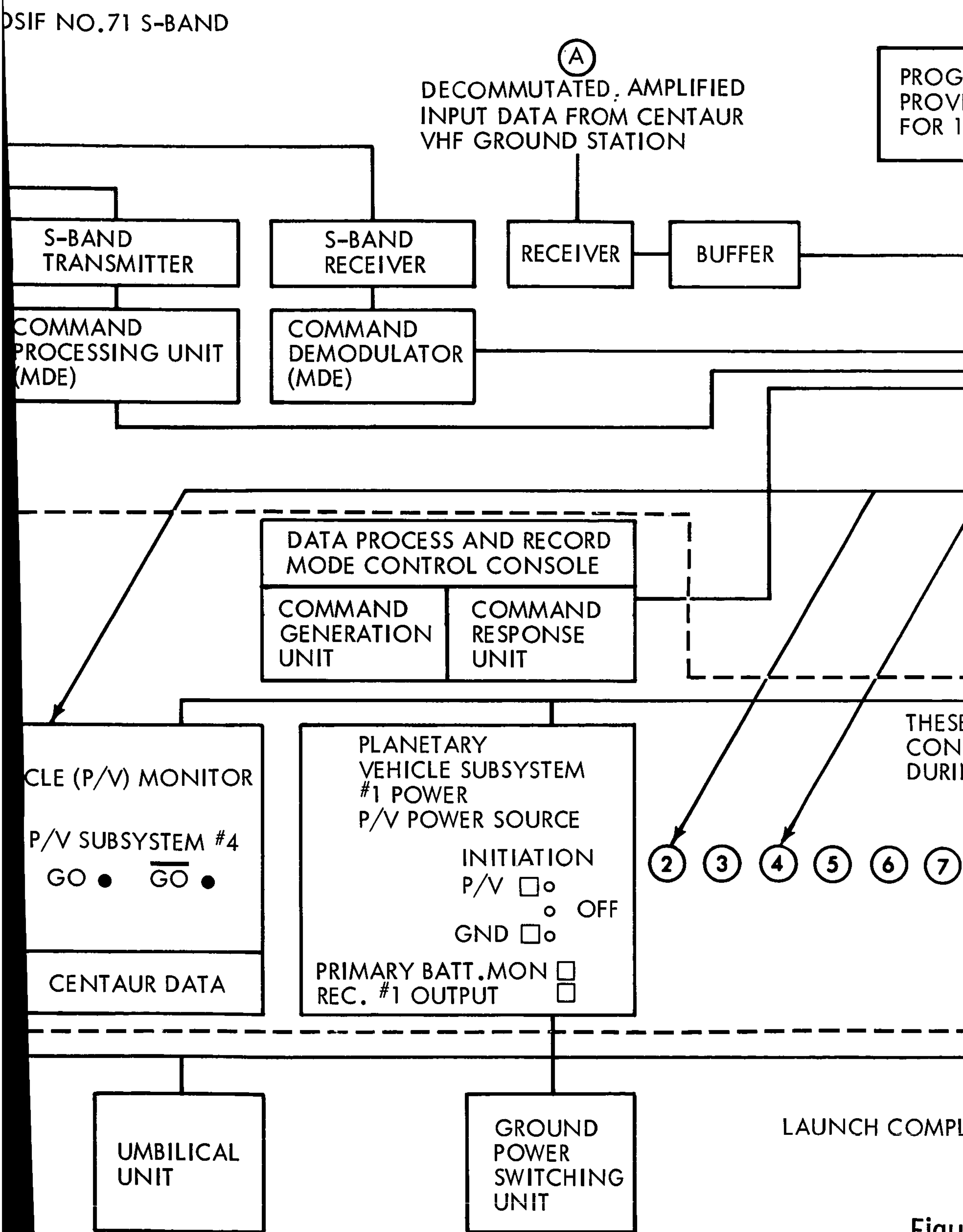
II 3.1 MISSION DEPENDENT EQUIPMENT (MDE) FUNCTIONAL DESCRIPTION

The functional descriptions of MDE noted in Section 3.1 of D2-82709-3 apply to the 1969 test flight with the following exceptions described below and indicated on Figure 3.2-1.

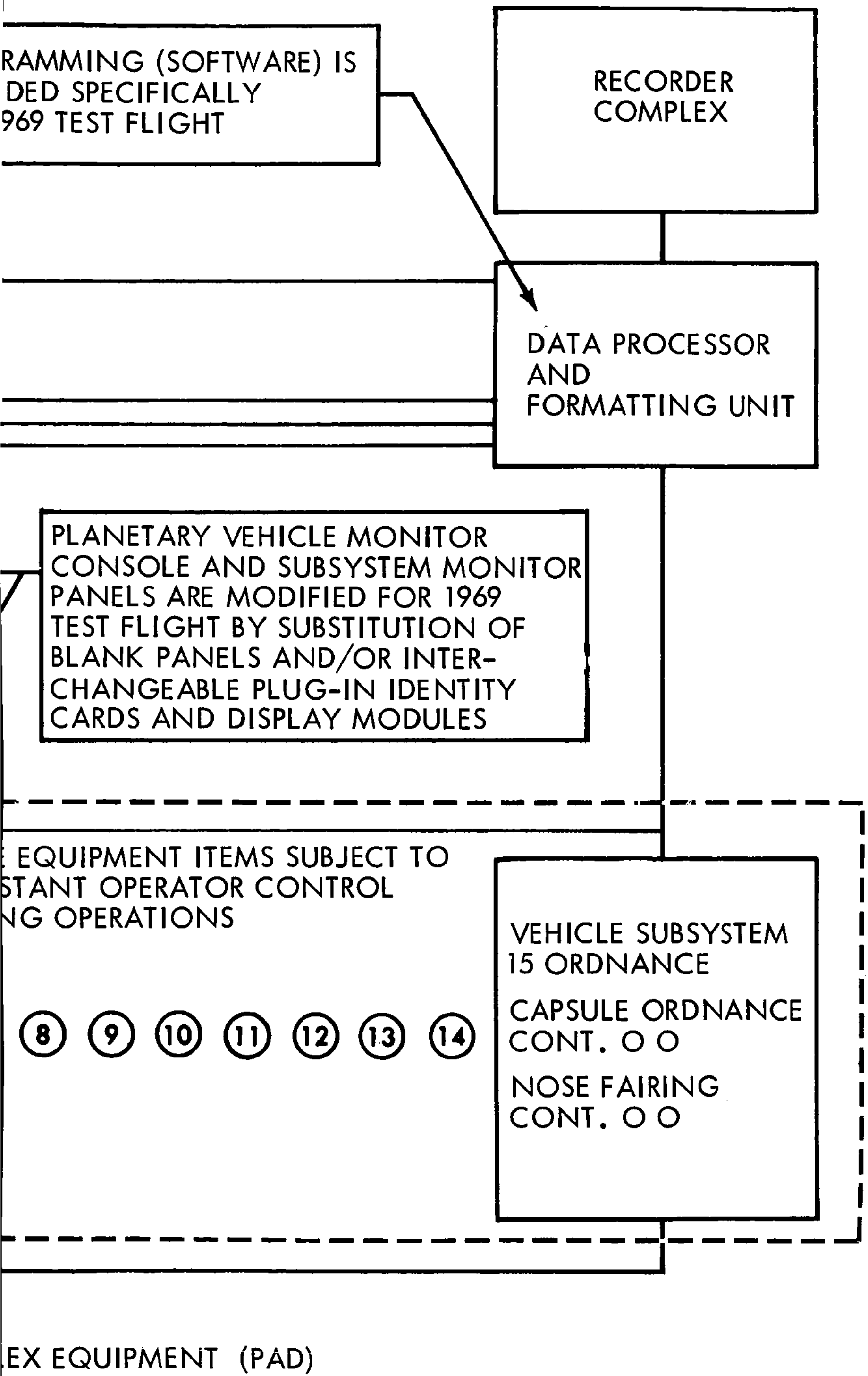
The software used at the DSIF and the SFOF has the capacity to process a greater amount of engineering data but need not have the capacity to process capsule science data. Quantities of MDE hardware required at the DSIF are reduced.



NOSE FAIRING
PLANETARY VEHICLE
BUS
RF
BOOM (U.T.)
REPEATER
TO D
HARDLINE
ALTERNATE LINKS
RF HOOD FOR 1969 TEST FLIGHT DIFFERENT FROM 1971 MISSION
CENTAUR VHF TELEMETRY
A
TO AF-ETR VHF FACILITIES
SPACE VEHICLE
CENTAUR
PLANETARY VEHI
P/V STATUS
LAUNCH
LAUNCH
P/V POWER
TIME 4321
1969 UMBILICAL SET MAY BE DIFFERENT LENGTH THAN SET PROVIDED FOR THE 1971 MISSION


DSIF NO.71 S-BAND
A
DECOMMUTATED, AMPLIFIED
INPUT DATA FROM CENTAUR
VHF GROUND STATION
PROG
PROV
FOR 1
S-BAND TRANSMITTER
S-BAND RECEIVER
RECEIVER
BUFFER
COMMAND PROCESSING UNIT (MDE)
COMMAND DEMODULATOR (MDE)
DATA PROCESS AND RECORD MODE CONTROL CONSOLE
COMMAND GENERATION UNIT
COMMAND RESPONSE UNIT
CLE (P/V) MONITOR
P/V SUBSYSTEM #4
GO
GO
CENTAUR DATA
PLANETARY VEHICLE SUBSYSTEM #1 POWER
P/V POWER SOURCE
INITIATION
P/V
OFF
GND
PRIMARY BATT.MON
REC. #1 OUTPUT
THESE
CON
DURI
2
3
4
5
6
7
UMBILICAL UNIT
GROUND POWER SWITCHING UNIT
LAUNCH COMPL

Figu



re 3.2-1: Voyager OSE/LCE Launch-Pad Operations — LCE Variations for 1969 Flight Test

II 3.2 LAUNCH COMPLEX EQUIPMENT FUNCTIONAL DESCRIPTION

The LCE for the 1969 test flight will be the same as that described in Section 3.2 of D2-82709-3 for the 1971 Voyager mission, except as noted below.

1) Programming (software) for the data processor and formatting unit is provided specifically for the 1969 flight test.

2) The Planetary Vehicle monitor console as planned for 1971 is used for the 1969 test flight. Engineering flight data display increases are accommodated by the use of module locations made available by the deletion of the spacecraft science payload and capsule measurement requirements and the reduction in spacecraft power monitoring requirements. Substitutions of appropriately engraved plastic function identity cards on the console front panels and interchangeable plug-in standard numeric modules and standard status modules will be made to accommodate the additional engineering data displays. The quantity of added engineering data displays is limited to the number of functions deleted from subsystems monitor panels having reduced or deleted requirements for monitor displays.

3) The Science Payload and Capsule Subsystem Monitor Panels are blanked as required where subsystem functions are deleted, or engineering measurements for other subsystems are displayed in these Panels.

4) Monitor functions eliminated by the deletion of one of the three spacecraft batteries in the Power Subsystem will be blanked out on the Power Subsystem Monitor Panel. The Module space on the

PV Monitor Console is available for additional engineering data displays.

5) The physical length of the umbilical hardlines may require change but the basic configuration for 1969 is the same as for 1971 and the electrical impedance is required to match 1971 configuration.

The modifications provided for the Atlas/Centaur launched 1969 test flight do not affect evaluation of LCE performance suitability for Voyager 1971 mission.

II 3.3 STC FUNCTIONAL DESCRIPTION

The STC for the Atlas/Centaur launched 1969 test flight is identical in design to that described functionally in Section 3.3 of D2-82709-3 for the 1971 mission, except that the specific equipments required to permit testing with the Flight Capsule and the Science Package installed or simulated are not installed. Space, power and environmental control provisions are, however, included to permit incorporation of the above test equipment items with minor rework.

II 3.4 ASSEMBLY, HANDLING, AND SHIPPING EQUIPMENT (AHSE) -- SYSTEM LEVEL

The functional descriptions of system level AHSE for the Atlas/Centaur launched 1969 test flight are as described in D2-82709-3, Section 3.4 with the following exceptions. Spacecraft structural changes affecting the OSE are:

1) a) No VHF antenna,

   b) eight foot parabolic high-gain antenna,

c) modified high-gain antenna support structure,

d) reduced and reoriented solar panels.

These changes affect a) the mechanism deployment test stand, b) the magnetic mapping test stand, and c) alignment stations.

2) Elimination of capsule and science payload deletes requirement for this AHSE.

3) The smaller Atlas/Centaur nose fairing requires changes of the encapsulation area platform set, and new AHSE in lieu of similar equipment for the Saturn IB/Centaur configuration, as follows:

a) Acoustic Test Fixture

b) Test Stand - Spacecraft/Nose Fairing Separation

c) Test Fixture - Antenna Range and EI Test

c) Transporter, Encapsulated Flight Spacecraft

e) Access Equipment

f) Simulated Nose Fairing

g) Encapsulated in Nose Fairing Spacecraft Lifting Fixture

h) Spacecraft to Launch Vehicle Installation Kit

i) Nose Fairing to Spacecraft Installation Kit

4) Changes to the propulsion module allows deletion of the rocket motor alignment fixture and requires modified equipment designs as follows: (a) portable blast barrier and (b) propellant shields.

5) The use of AFETR launch pad 36 requires minor modifications to the handling, access and certain safety AHSE used at the pad.

II 3.5 SPACECRAFT SIMULATOR

The Spacecraft Simulator for the Atlas/Centaur Launched 1969 test flight will be the same as the 1971 spacecraft simulator (Reference D2-82709-3, Section 3.5) with the following exceptions:

1) There need be no provisions for interconnecting the Flight Capsule Simulator or the Science Payload Simulator.

2) The 1969 Simulator will be designed to interface with AFETR launch complexes 36A and 36B.

II 3.6 SPECIAL SYSTEM LEVEL OSE, FUNCTIONAL DESCRIPTIONS

This equipment includes that for trend data analysis and that for magnetic mapping.

II 3.6.1 Function Descriptions of the Trend Data Equipment

This category of OSE is identical to that described in 3.6.6 of D2-82709-3 except for differences in software resulting from the eliminations of the VHF radio and antenna orbit insertion solid rocket motor, the Flight Capsule, the Science Package and the minor differences in the Spacecraft bus.

II 3.6.2 Magnetic Mapping Equipment Functional Description

This equipment is identical to the magnetic mapping equipment described in 3.6.2 except for the differences in supporting AHSE described in 3.4 of this document.

II 3.7 EQUIPMENT LIST

The system level OSE equipment required for the 1969 Voyager test flight using the Atlas/Centaur launch vehicle is listed in the following tables.

The listing is tabulated by category, and an identification number is assigned to each item. This identification number also relates the item to the subsection of Section 3 which describes the equipment category. Use assignments for each item are indicated by an "X" in the appropriate column. Space is provided to add equipment quantities at a later point in the program.

ITEM NO.	SYSTEM LEVEL OSE CATEGORY: MISSION DEPENDENT EQUIPMENT (MDE) for 1969 Test Flight with Atlas/Centaur Launch Vehicle		USE ASSIGNMENTS: KENT FACILITY, SEATTLE	SCF (AFETR)	ESA (AFETR)	OTHER AFETR Magnetic Mapping	LAUNCH PAD 34	LAUNCH PAD 37	DSIF STATION	SFOF
3.1										
3.1.1	High Bit Rate Subcarrier Demodulator, Bit Synchronizer and Data Reconstructor		X	X	X	X	X	X	X	
3.1.2	Low Bit Rate Subcarrier Demodulator, Bit Synchronizer and Data Reconstructor		X	X	X	X	X	X	X	
3.1.3	Master Decommutator and Frame Synchronizer		X	X	X	X	X	X	X	
3.1.4	Engineering Data Decommutator		X			X	X	X	X	
3.1.5	Engineering Data Frame Sync Recognizer		X			X	X	X	X	
3.1.6	Engineering Data Subframe Sync Recognizer		X			X	X	X	X	
3.1.7	Command Processor		X	X	X	X	X	X	X	
3.1.8	Frequency Down Converter		X						X	
3.1.9	Computer Interface Equipment		X	X	X	X	X	X	X	
3.1.10	Command Verification Processor (SDS 920 Software)		X	X	X	X	X	X	X	
3.1.11	Command Transmission Processor (SDS 920 Software)		X	X	X	X	X	X	X	
3.1.12	Input Trap Processor (SDS 920 Software)		X	X	X	X	X	X	X	
3.1.13	Telemetry Processor (SDS 920 Software)		X	X	X	X	X	X	X	
3.1.14	Output Processor (SDS 920 Software)		X	X	X	X	X	X	X	
3.1.15	Subcarrier Demodulator & Bi-Orthogonal Block Decoder		X	X						X
3.1.16	Predetected Tape Demodulator		X	X						X
3.1.17	Input Processor (7040/7044 Software)		X							X
3.1.18	Output Processor (7040/7044 Software)		X							X

ITEM NO.	SYSTEM LEVEL OSE CATEGORY: MISSION DEPENDENT EQUIPMENT (MDE) for 1969 Test Flight with Atlas/ Centaur Launch Vehicle		USE ASSIGNMENTS: KENT FACILITY, SEATTLE	SCF (AFETR)	ESA (AFETR)	OTHER AFETR Magnetic Mapping	LAUNCH PAD 34	LAUNCH PAD 37	DSIF STATION	SFOF	
3.1.19	Telemetry Processor (7040/7044 Software)		X							X	
3.1.20	Input Processor (IBM 7094 Software)		X							X	
3.1.21	Telemetry Processor (IBM 7094 Software)		X							X	
3.1.22	Output Processor (IBM 7094 Software)		X							X	
3.1.23	IBM 7040 Command Processor (Software)		X							X	
3.1.24	Flight Path Analysis Program (IBM 7094 Software)		X							X	
3.1.25	Spacecraft Performance Analysis Program (IBM 7094 Software)		X							X	
3.1.26	Manual Analysis Aids (Software)		X							X	
3.1.27	Mission Integration and Control (Software)		X							X	

ITEM NO.	SYSTEM LEVEL OSE CATEGORY: LAUNCH COMPLEX EQUIPMENT (LCE) for 1969 Test Flight with Atlas/Centaur Launch Vehicle	USE ASSIGNMENTS	KENT FACILITY, SEATTLE	SCF (AFETR)	ESA (AFETR)	OTHER AFETR Magnetic Mapping	LAUNCH PAD 34	LAUNCH PAD 37	DSIF STATION	SFOF
3.2.1	Ground Power Switching Unit			X		X	X			
3.2.2	Umbilical Function Unit			X		X	X			
3.2.3	S-Band Two-Way Repeater					X	X			
3.2.4	Umbilical Set					X	X			
3.2.5	Repeater Cabling Set					X	X			
3.2.6	S-Band Transmitter			X	X	X	X			
3.2.7	S-Band Receiver			X	X	X	X			
3.2.8	Centaur VHF Landing Receiver					X	X			
3.2.9	Centaur VHF Data Buffer					X	X			
3.2.10	Data Processor and Formatting Unit			X	X	X	X			
3.2.11	Recorder Complex			X	X	X	X			
3.2.12	Data Process and Record Mode Control Console			X	X	X	X			
3.2.13	Planetary Vehicle Monitor Console			X	X	X	X			
3.2.14	Radio Subsystem Monitor Panel (SSMP)			X	X	X	X			
3.2.15	Telemetry and Data Storage SSMP			X	X	X	X			
3.2.16	Antenna SSMP			X	X	X	X			
3.2.17	Attitude Reference SSMP			X	X	X	X			
3.2.18	Autopilot SSMP			X	X	X	X			
3.2.19	Science Payload SSMP [1]			X	X	X	X			

[1] Items indicated will be supplied, but engineering data will be displayed, as required, in place of subsystem functions not provided in 1969 Test Flight

ITEM NO.	SYSTEM LEVEL OSE CATEGORY: LAUNCH COMPLEX EQUIPMENT (LCE) for 1969 Test Flight with Atlas/Centaur Launch Vehicle	USE ASSIGNMENTS: KENT FACILITY, SEATTLE	SCF (AFETR)	ESA (AFETR)	~~OTHER AFETR~~ Magnetic Mapping	LAUNCH PAD 34	LAUNCH PAD 37	DSIF STATION	SFOF
3.2.20	Thermal Control SSMP			X	X	X	X		
3.2.21	Propulsion SSMP			X	X	X	X		
3.2.22	Reaction Control SSMP			X	X	X	X		
3.2.23	CC&S SSMP [1]			X	X	X	X		
3.2.24	Power SSMP [1]			X	X	X	X		
3.2.25	Capsule SSMP			X	X	X	X		
3.2.26	Data Processor/Formatter (Software)			X	X	X	X		
3.2.27	Antenna/Diplexer			X	X				
3.2.28	Interconnecting Cabling, ESA			X	X				
3.2.29	Portable Air Conditioning Unit	X		X	X	X	X		
3.2.30	Interconnecting Cabling, LCE			X	X	X	X		
3.2.31	Portable Cooling Unit					X	X		
MDE	As shown in usage charts for MDE								

[1] Items indicated will be supplied, but engineering data will be displayed, as required, in place of subsystem functions not provided in 1969 Test Flight.

ITEM NO.	SYSTEM LEVEL OSE CATEGORY: SYSTEM TEST COMPLEX (STC) for 1969 Test Flight with Atlas/Centaur Launch Vehicle		USE ASSIGNMENTS: KENT FACILITY.	SEATTLE	SCF (AFETR)	ESA (AFETR)	OTHER AFETR	LAUNCH PAD 34	LAUNCH PAD 37	DSIF STATION	SFOF
3.3.1	Programmer		X	X					X	X	
3.3.2	Programs (Software)		X	X					X	X	
3.3.3	Data Display and Printer		X	X					X		
3.3.4	Data Recorder		X	X					X		
3.3.5	Rack Structure and Cooling System		X	X					X		
3.3.6	Rack Power System, and Electrical Wiring		X	X					X		
3.3.7	Science Package Simulator		X	X					X		
3.3.8	Flight Capsule Simulator		X	X					X		
3.3.10	Centaur Data Link Processor		X	X					X		
3.3.11	External Cables		X	X					X		
[1] SSTE	Telecommunications (STC Components)		X	X					X		
[1] SSTE	Electric Power (STC Components)		X	X					X		
[1] SSTE	Central Computer and Sequencer (STC Components)		X	X					X		
[1] SSTE	Attitude Ref. and Autopilot (STC Components)		X	X					X		
[1] SSTE	Mechanisms-Temperature Control (STC Components)		X	X					X		
[2] GFE	Computer (SDS-920 or Equiv.)		X	X					X		
MDE	As shown in usage charts for MDE.										

[1] Subassembly of the noted set of SSTE.

[2] Government Furnished Equipment Item used in STC.

ITEM NO.	SYSTEM LEVEL OSE CATEGORY: ASSEMBLY, HANDLING & SHIPPING EQUIPMENT (AHSE) for 1969 Test Flight with Atlas/Centaur Launch Vehicle		USE ASSIGNMENTS: KENT FACILITY, SEATTLE	SCF (AFETR)	ESA (AFETR)	OTHER AFETR Magnetic Mapping	LAUNCH PAD 36		DSIF STATION	SFOF
	MEASUREMENT EQUIPMENT MECHANICAL									
3.4.1	Alignment Station (less adapters)(1969 Modified)		X	X						
3.4.2	Weight/Balance Equipment		X		X					
	TEST STANDS AND FIXTURES									
3.4.4	Free Mode Test Stand		X							
3.4.5	STC System Level Test Stand		X	X						
3.4.6	Mechanism Deployment Test Stand (1969 Modified)		X	X						
3.4.7	Spacecraft/Nose Fairing Separation Test Fixture		X							
3.4.8	Goldstone Test Stand				GOLDSTONE					
3.4.9	Antenna Range and EI Test Fixture (1969 New)		X							
3.4.10	Acoustic Test Fixture (1969 New)		X							
3.4.11	Magnetic Mapping Test Stand (1969 Revised)		X			X				
	TRANSPORTATION EQUIPMENT									
3.4.13	Transport, Encapsulated Flight Spacecraft (1969 New)		X		X		X			
3.4.14	Remote Site OSE Set Transporter		X	X	X					
3.4.15	OSE Transporter		X	X	X				X	X

ITEM NO.	SYSTEM LEVEL OSE CATEGORY: ASSEMBLY, HANDLING & SHIPPING EQUIPMENT (AHSE) for 1969 Test Flight with Atlas/Centaur Launch Vehicle		USE ASSIGNMENTS: KENT FACILITY, SEATTLE	SCF (AFETR)	ESA (AFETR)	Magnetic Mapping AFETR	LAUNCH PAD 36	DSIF STATION	SFOF
	SAFETY DEVICES								
3.4.16	Portable Blast Barrier (1969 Revised)		X		X		X		
3.4.18	Propellant Shields (1969 Revised)		X		X				
	WORK PLATFORM SETS AND ACCESS EQUIPMENT								
3.4.19	S/C Assembly Platform Set		X	X					
3.4.20	ESA Testing Platform Set		X		X				
3.4.21	STC Testing Platform Set		X	X					
3.4.22	Goldstone Platform Set				G O L D S T O N E				
3.4.23	Kent Space Chamber Platform Set		X						
3.4.24	Encapsulation Area Platform Set (1969 Revised)				X				
3.4.26	Weight/Balance Area Platform Set		X		X				
3.4.27	Umbilical Installation Access Equipment (GFE)						X		
3.4.28	Simulator Usage Access Equipment		X	X	X		X		
3.4.29	Encapsulated Flight Spacecraft Installation to Launch Vehicle Access Equipment (1969 New)						X		
3.4.30	OSE Operation Access Equipment		X	X	X				

ITEM NO.	SYSTEM LEVEL OSE CATEGORY: ASSEMBLY, HANDLING & SHIPPING EQUIPMENT (AHSE) for 1969 Test Flight with Atlas/Centaur Launch Vehicle		USE ASSIGNMENTS: KENT FACILITY, SEATTLE	SCF (AFETR)	ESA (AFETR)	OTHER AFETR	LAUNCH PAD 36	DSIF STATION	SFOF
	DOLLYS, TRUCKS (SHOP) AND INSTALLATION DEVICES								
3.4.31	General Purpose Dolly for Voyager Components		X	X	X				
3.4.32	Spacecraft Components Installation Device		X	X	X				
	PROTECTIVE COVERS								
3.4.33	STC Area Protective Cover		X	X					
3.4.34	Goldstone Protective Cover					GOLDSTONE			
3.4.35	Simulated Nose Fairing (1969 New)		X	X	X				
3.4.36	Portable Clean Rooms		X	X	X	Also GOLDSTONE			
3.4.37	Fueling Protective Devices (1969 Revised)		X		X				
3.4.38	Transport or Storage Cover		X	X	X				
3.4.39	Sterilization Enclosures		X		X				
	SHIPPING CONTAINERS								
3.4.40	Spacecraft Container		X	X		Also GOLDSTONE			
	LIFTING DEVICES								
3.4.41	Flight Spacecraft with Nose Fairing (1969 New)		X		X		X		
3.4.43	Flight Spacecraft		X	X	X				
3.4.44	Sling Set for System Level		X	X	X		X		

ITEM NO.	SYSTEM LEVEL OSE CATEGORY: ASSEMBLY, HANDLING & SHIPPING EQUIPMENT (AHSE) for 1969 Test Flight with Atlas/Centaur Launch Vehicle		USE ASSIGNMENTS: KENT FACILITY,	SEATTLE	SCF (AFETR)	ESA (AFETR)	OTHER AFETR	LAUNCH PAD 36	DSIF STATION	SFOF
	LIFTING DEVICES (Continued)									
3.4.45	OSE Lifting and Installation Set		X	X	X		X		X	X
	INSTALLATION KITS AND ASSEMBLY JIGS									
3.4.46	Spacecraft to Launch Vehicle Kit		X				X			
3.4.47	Nose Fairing to Spacecraft		X		X					
3.4.49	Flight S/C to S/C Adapter Kit		X	X	X					
3.4.51	S/C Bus Jig		X	X						

ITEM NO.	SYSTEM LEVEL OSE CATEGORY: MAGNETIC MAPPING EQUIPMENT (LCE) 1969 Test Flight with Atlas/Centaur Launch Vehicle		USE ASSIGNMENTS: KENT FACILITY, SEATTLE	SCF (AFETR)	ESA (AFETR)	OTHER AFETR Magnetic Mapping	LAUNCH PAD 34	LAUNCH PAD 37	DSIF STATION	SFOF
3.6.1	X-Y Plotter		X			X				
3.6.2	Air Conditioning Hose Set		X			X				
3.6.3	Fluxgate Magnetometer		X			X				
3.4.4	Solar Panel Mapping Fixture		X			X				
3.6.5	Solar Cell Simulator		X			X				

II 4.0 SUBSYSTEM TEST EQUIPMENT

II 4.1 TELECOMMUNICATION SUBSYSTEM OSE

The telecommunications OSE for the 1969 test flight launched by the Atlas/Centaur is identical to that defined for the 1971 mission in D2-82709-3, Paragraph 4.1, with the following exceptions:

1) The relay radio subsystem test set and the relay radio subsystem shipping container will not be required because the Capsule is not included in the test flight spacecraft configuration.
2) In conducting subsystems integration tests, a standard digital signal will be used as an input to the T/M and data storage subsystem. This differs from the 1971 integration tests which input a VHF test signal into the relay radio subsystem via the VHF antenna.
3) The component mounting interface mock-up will be modified by the omission of the cable connectors for interface between the T/M and data storage subsystem and the relay radio subsystem.

II 4.2 POWER SUBSYSTEM OSE

The power subsystem OSE for the 1969 test flight, launched by the Atlas/Centaur, is identical to that defined for the 1971 mission in D2-82709-3, Paragraph 4.2, except that minor changes in AHSE are required to provide compatibility with the revised mounting provisions on the solar panels.

The 1971 OSE design provides adequate flexibility to handle the Atlas/Centaur launched test flight spacecraft power subsystem design. Changes in the test flight power subsystem from the 1971 design include:

a) Increase in engineering data used to monitor spacecraft power subsystem performance.

b) Decrease in spacecraft batteries from three to two.

c) Decrease in the number of solar panel structural sections from six to three.

It is planned that no additions will be made to the 1969 power subsystem OSE for the 1971 mission except in those cases where the 1969 test has indicated a need for improvement.

II 4.3 PROPULSION SUBSYSTEM OSE

The propulsion subsystem OSE for the 1969 test flight, launched by the Atlas/Centaur, is identical to that defined for the 1971 mission in D2-82709-3, Paragraph 4.3, except as noted below.

The 1969 test flight with the Atlas/Centaur does not include an orbit insertion maneuver. The deletion of this requirement eliminates the requirement for the orbit insertion solid rocket motor and reduces the propellant requirements in the midcourse and orbit trim liquid rocket system.

The differences in the 1969 Atlas/Centaur and 1971 Voyager propulsion system result in the following operational support equipment differences:

1) Delete requirement for rocket motor transporter.

2) Delete requirement for TVC Freon servicing unit.

The remaining operational support equipment must be capable of handling a smaller module with reduced propellant and pressurant loading requirements.

While the above noted OSE differences exist, the 1969 test flight will still be highly desirable in evaluating the propulsion OSE in a realistic environment.

II 4.4 ENGINEERING MECHANICS

The Mechanisms, Packaging & Cabling, Temperature Control and Pyrotechnics OSE for the Atlas/Centaur launched 1969 test flight is identical to that described in D2-82709-3, Paragraph 4.4 for the 1971 mission, except that: 1) the requirement to align the magnetometer is eliminated, since this instrument will not be included in the spacecraft; 2) because the scientific payload instruments are removed from this test flight, the check out requirements associated with the deleted instrument is eliminated.

Although the number of pyrotechnic devices are reduced on this spacecraft, dummy loads are provided for each of the devices not included and the complete firing sequence will be simulated.

The 1969 test will afford an opportunity to operate the OSE under a realistic mission environment and allow refinements and improvements in methods, processes and techniques to be incorporated into the 1971 OSE.

II 4.5 SPACE SCIENCE OSE

The 1969 test spacecraft configuration launched by the Atlas/Centaur is defined in D2-82709-4, Part II. As such it carries no science payload. Therefore, no space science OSE is required for this 1969 test flight.

II 4.6 ATTITUDE REFERENCES AND AUTOPILOT OSE

The attitude references and autopilot OSE for the Atlas/Centaur launched 1969 test flight is identical to that described in D2-82709-3, Paragraph 4.6, except as noted below.

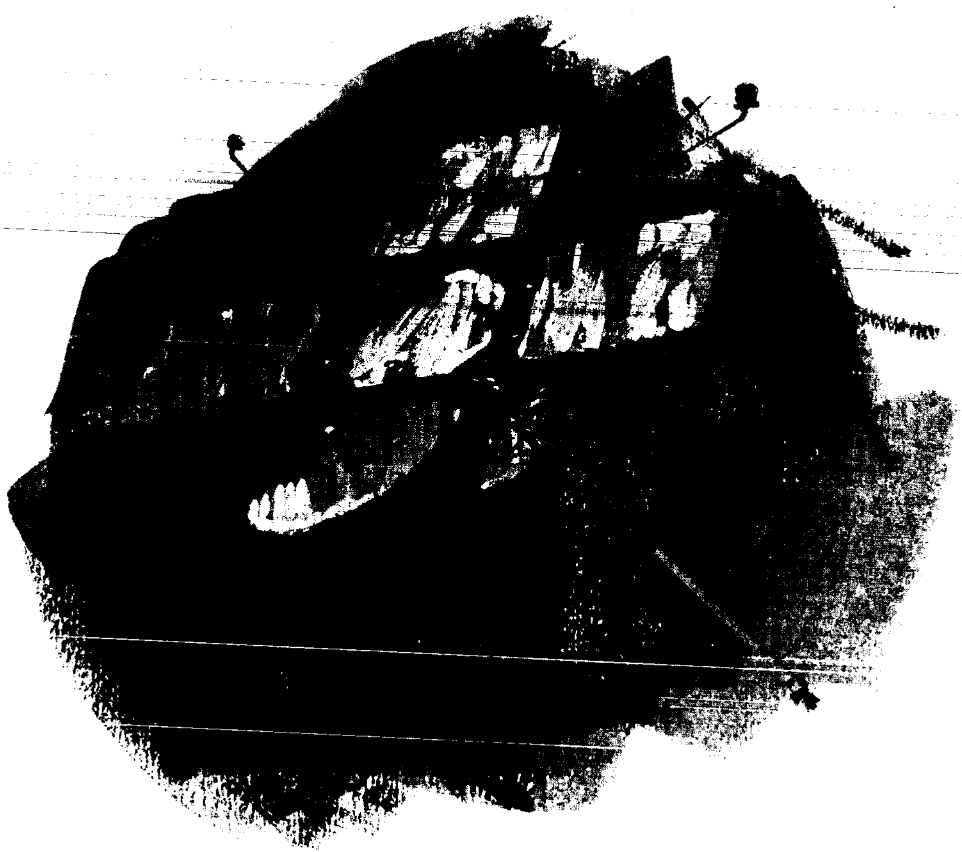
1) Signal Monitoring--The signals appearing on the test connector for the 1971 mission will be telemetered on the 1969 mission. The monitoring of these signals by the OSE is provided for in the 1971 OSE configuration for subsystems tests. In the system test complex, the 71 configuration provides direct connection to the test connector. In the 69 configuration these signals will be monitored through the telemetry link which requires an additional interface between the telecommunications OSE and the attitude reference and autopilot OSE to recover these signals. The normal (71) telemetry data is recovered by this link as shown in Volume C, Paragraph 4.6.
2) Programming--The programming for both the local tape reader and remote computer will be changed to accommodate the monitoring of the additional signals through the telemetry link. Changes in the programming are also required to be compatible with the modified gains in the autopilot, for Atlas vehicle inertia, and for exercising the accelerometer self-test feature.

II 4.7 CENTRAL COMPUTER AND SEQUENCER (CC&S) OSE

The Central Computer and Sequencer OSE for the 1969 test flight, launched by the Atlas/Centaur, is identical to that defined for the 1971 mission in D2-82709-3, Paragraph 4.7, except as noted below.

The major difference between the 1969 Atlas/Centaur launched test flight and the 1971 mission that affects the CC&S, is the deletion of the Flight Capsule in the 1969 spacecraft. Electrical interfaces simulating the Flight Capsule that will be installed in the 1969 test vehicle will also be simulated in the CC&S OSE. The test tapes used to program the CC&S OSE will be modified to reflect the 1969 test flight, including Flight Capsule dummy loads. Emphasis on real time command, command message verification and message error testing plus stored program sequencing verification is planned using the CC&S OSE.

The CC&S OSE will be capable of performing all its functions to assure the complete flight readiness of the CC&S as installed in the 1969 test vehicle. The performance of those functions will also obtain maximum benefit from the 1969 test flight by assuring a high degree of confidence for the 1971 mission.



CONTENTS

PART III OSE FOR SATURN IB/CENTAUR LAUNCHED 1969 TEST FLIGHT

III 1.0 OSE OBJECTIVES AND DESIGN CRITERIA

This section of the document records the objectives and design criteria that are unique to the operational support equipment (OSE) for the 1969 test spacecraft launched by the Saturn IB/Centaur.

Definitions of the various required categories of OSE are identical to those in Section 1.0 of D2-82709-3, except that: 1) References to the Science Package, or the Flight Capsule, apply to the Simulated Science Package and the Simulated Flight Capsule.

III 1.1 SPACECRAFT SYSTEM OSE OBJECTIVES AND CRITERIA

The primary objective of the operational support equipment (OSE) for the 1969 test flight is the enhancement of the probability of success for the Voyager 1971 mission. Additional OSE objectives in support of the 1969 test spacecraft are identical to those listed in D2-82709-3, Paragraph 1.1.

III 2.0 OSE DESIGN CHARACTERISTICS AND RESTRAINTS

The OSE design characteristics and restraints for the Voyager '71 mission, noted in Section 2.0 of D2-82709-3, apply to the Saturn IB/Centaur launched 1969 test spacecraft except as noted below.

All references in Section 2.0 of D2-82709-3 to the Science Payload or the Flight Capsule apply to the Simulated Science Payload or the Simulated Flight Capsule.

III 2.1 OSE SEQUENTIAL FLOW CHART

The processing of the flight hardware for the 1969 test flight spacecraft and the related 1969 PTM test activities are essentially the same as those shown in the flow chart of D2-82709-3, Figure 2.1-1 and the analysis matrices of Figures 2.1-2 through 2.1-6. In fact, the duplication of the kinds of tests and their sequencing is significant to proofing or validation of this processing for the 1971 mission flight hardware processing.

The differences in flow that are a consequence of differences in test flight configuration requirements are as follows: Capsule and Science Payload test and operations activities are modified as required for a simulated capsule rather than a "live" capsule and a "live" science payload.

III 2.2 OSE DESIGN PARAMETERS

OSE design parameters for the Saturn IB/Centaur launched 1969 test flight are the same as those defined for the 1971 mission in D2-82709-3, Section 2.2, Tables 2.2-1 through 2.2-4.

III 2.3 OSE DESIGN CRITERIA

OSE design criteria for the Saturn IB/Centaur launched 1969 test flight are identical to those defined for the 1971 mission in D2-82709-3, Paragraph 2.3.

III 3.0 FUNCTIONAL DESCRIPTION - SYSTEM LEVEL OSE

This section provides functional descriptions of the Systems level OSE for the Saturn IB/Centaur launched 1969 test flight, in terms of exceptions to the OSE design for the 1971 Mission.

III 3.1 MDE FUNCTIONAL DESCRIPTION

The Mission Dependent Equipment for the 1969 Saturn IB/Centaur launched test flight, is identical to that defined for the 1961 mission in D2-82709-5 paragraph 3.1 except as noted below.

Software is modified to be compatible with the test flight profile, the replacement of the Science Payload and the Capsule by simulators, and the increased availability of engineering data channels.

III 3.2 LCE FUNCTIONAL DESCRIPTION

The LCE is identical to the LCE for the 1971 mission described in D2-82709-3, Section 3.2, with the exception that:

1) Fewer display and data channels are required for the simulated Spacecraft Science Subsystem and Simulated Capsule than for the 1971 Science Subsystem and Capsule.
2) Increased Spacecraft engineering data channel capability is provided.

III 3.3 STC FUNCTIONAL DESCRIPTION

The STC is identical to the STC for the 1971 mission described in D2-82709-3, Section 3.3, with the exceptions noted below.

1) The STC supports the integration of the Simulated Spacecraft Science Subsystem and Simulated Capsule, rather than the operational Science subsystem and Capsule.

2) The STC uses the telemetry OSE channels not used for Capsule and Science to provide increased capability for acquiring Spacecraft engineering data.

III 3.4 AHSE FUNCTIONAL DESCRIPTION

The AHSE is identical to the AHSE for the 1971 mission defined in D2-82709-3, Section 3.4.

III 3.5 SPACECRAFT SIMULATOR

The Spacecraft Simulator is identical to the Spacecraft Simulator for the 1971 mission defined in D2-82709-3, Section 3.5.

III 3.6 SPECIAL SYSTEM LEVEL OSE

The trend data equipment is identical to that for the 1971 mission described in D2-82709-3, Section 3.6, except that software changes are required to handle the Science and Capsule simulators, and to support the increased capability for Spacecraft Engineering Data.

The magnetic mapping equipment is identical to that described in D2-82709-3, Section 3.6.

III 4.0 SUBSYSTEM TEST EQUIPMENT

III 4.1 TELECOMMUNICATIONS

The Telecommunications OSE for the Saturn IB/Centaur 1969 Test Flight is identical to that defined for the 1971 mission in D2-82709-3, Paragraph 4.1.

III 4.2 POWER SUBSYSTEM OSE

The power subsystem OSE for the Saturn IB/Centaur 1969 Test Flight is identical to that defined for the 1971 mission in D2-82709-3, Paragraph 4.2.

III 4.3 PROPULSION AND REACTION CONTROL OSE

The Propulsion and Reaction Control OSE for the Saturn IB/Centaur 1969 Test Flight is identical to that defined for the 1971 mission in D2-82709-3, Paragraph 4.3.

III 4.4 ENGINEERING MECHANICS

The Engineering Mechanics OSE for the Saturn IB/Centaur 1969 Test Flight is identical to that defined for the 1971 mission in D2-82709-3, Paragraph 4.4 with the following exceptions:

1) Magnetometer alignment provisions are not included.
2) Engineering mechanics checkout provisions are eliminated for those scientific payload instruments that are deleted for the test flight.

III 4.5 SPACE SCIENCE OSE

The 1969 test spacecraft as launched by the Saturn IB/Centaur is defined in D2-82709-4, Part III. It carries a simulated science payload in lieu of a science payload. It is expected that development and design of the OSE required to check out the simulated science payload would be carried out under the cognizance of the same agency that is responsible for the selection, design, development, and delivery of the space science experiments.

The OSE for the simulated space science payload must be capable of checkout and calibration of all simulator electrical interfaces with the spacecraft before installation of the simulator in the spacecraft. Definition of the interface would parallel the definition of the interface for the 1971 spacecraft defined in D2-82709-1 (see Section 4.5). Selected portions of the simulator will be used in the Systems Test Complex to provide the stimuli and measurement capability required for the functioning of the simulator during spacecraft system testing.

III 4.6 ATTITUDE REFERENCE AND AUTOPILOT

The Attitude Reference and Autopilot OSE for the Saturn IB/Centaur 1969 Test Flight is identical to that defined for the 1971 mission in D2-82709-3, Paragraph 4.6, with the exception of minor changes to match the telemetry outputs available at the spacecraft "OSE Connector."

III 4.7 CENTRAL COMPUTER AND SEQUENCER (CC&S) OSE

The CC&S OSE for the Saturn IB/Centaur 1969 Test Flight is identical to that defined for the 1971 mission in D2-82709-3, Paragraph 4.7.

ERRATA

The Boeing Company Document No. D2-82709-5, Voyager Spacecraft System Final Technical Report

VOLUME E

"Design for Operational Support Equipment--1969 Test Flight"

Page No.	Paragraph, Table, or Figure No.	
		Part II
II-5	Figure 3.2-1	VOYAGER OSE/LCE LAUNCH-PAD OPERATIONS-- LCE VARIATIONS FOR 1969 FLIGHT TEST On the space vehicle schematic shown at left side of page, move the rf hood and slot antenna for the 1969 test flight down to the cylindrical portion of the nose fairing. Delete antenna symbol and show transmission line from the bus to the relocated slot antenna.
II [illegible]	Para. II-3.7	SYSTEM LEVEL OSE CATEGORY (Equipment List) Delete items numbered 3.3.7 "Science Package Simulator" and 3.3.8 "Flight Capsule Simulator."